MP15AC

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OPERATOR'S MANUAL

Electro-Motive Division
La Grange, Illinois

GM

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1st Edition

October 1975

SERVICE DEPARTMENT

Electro-Motive Division
La Grange, Illinois

GM

Litho in U.S.A.

NOTICE

Data appearing in this manual is intended as an aid in explaining locomotive equipment used during operation. It is generally applicable to a basic locomotive, that is, a locomotive without optional extra equipment. Some data is also included for more frequently used extras. When special extra equipment is involved, consult specific drawings or instructions as provided by the railroad.

Information contained in this manual is based on data available when released for printing.

Minor equipment differences are due to changes made after the manual was published. Subsequent editions will cover these changes.

INTRODUCTION

This manual is a guide for railroad personnel operating General Motors Model MP15AC locomotives. Data is divided into four sections:

1. General Description -- Describes principal equipment components.
2. Controls -- Explains functions of controls used to start and operate the locomotive.
3. Operation – Outlines procedures for locomotive operation.
4. Troubleshooting – Describes probable causes of operating trouble and suggests operator action.

To be of most benefit to the reader, these sections should be read in sequence.

The Model MP15AC locomotive is illustrated in Fig. 1. Major equipment components are numbered and identified in the general arrangement drawing, Fig. 2. Some of these major components are described in the applicable sections of this manual.

Information for equipment maintenance, adjustment, and testing is contained in the Locomotive Service Manual. Instructions for testing and maintenance of individual locomotive components are a part of the standard EMD Maintenance Instruction bulletin series.

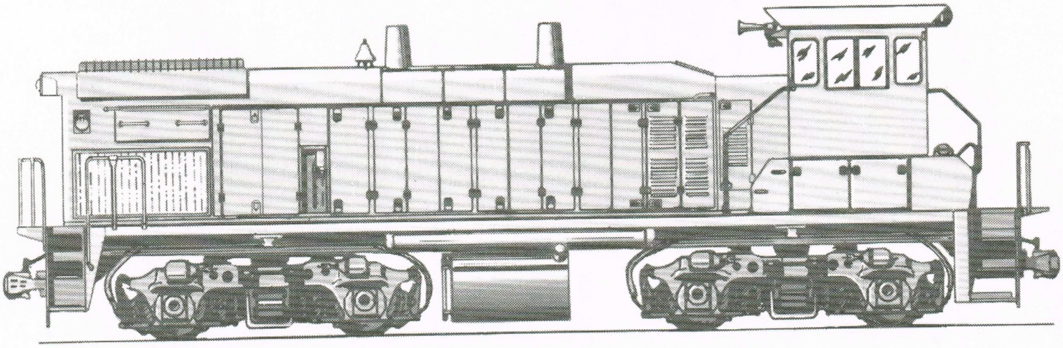
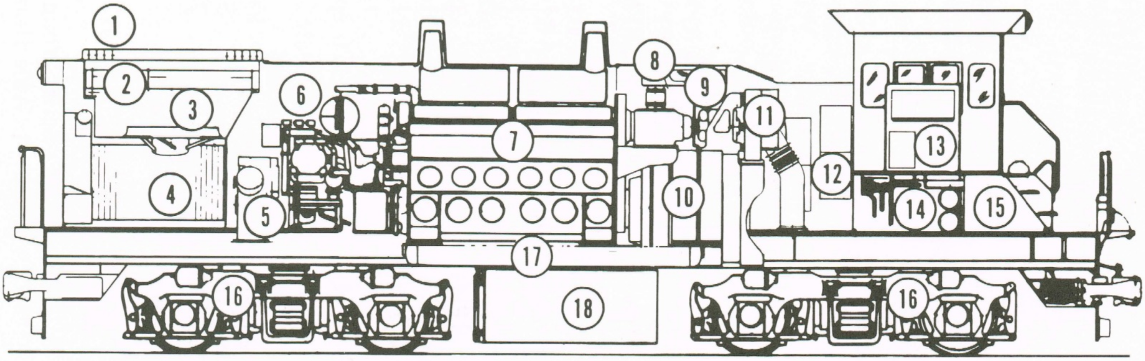


Fig. 1 – MP15AC Multipurpose Locomotive



1. Cooling Air Shutters
2. Radiators
3. Cooling Fan
4. Cooling Air Inlet Screen
5. Air Compressor
6. Equipment Rack
7. 645E Diesel Engine
8. Engine Air Filters
9. Auxiliary Generator
10. Main Generator
11. Traction Motor And Generator Blower
12. Carbody Air Filters
13. Control Stand
14. Air Brake Equipment And Electrical Switchgear
15. Battery Box And Sand Boxes
16. Truck
17. Air Reservoir
18. Fuel Tank

Fig. 2 – MP15AC Locomotive General Arrangement

GENERAL DATA

Model Designation	MP15AC
Locomotive Type	(B-B) 0440
Locomotive Horsepower	1500

Diesel Engine

Model	645E
Type	Blower Aspirated
Number Of Cylinders	12
Cylinder Arrangement	45° - "V"
Cylinder Bore And Stroke	9-1/16" x 10"
Operating Principle	Blower Scavenged 2-Stroke Cycle Unit Fuel Injection Water Cooled
Engine Speed	
Full	900 RPM
Idle	344 RPM
Idle - Switching 2 Mode	505 RPM

Main Generator Model	AR10 - D14
Traction Alternator (Rectified Output)	AR10
Number Of Poles	10
Nominal Voltage (DC)	600
Frequency (At 900 RPM)	75 cps
Companion Alternator	D14
Nominal Voltage (AC)	215
Number Of Poles	16
Frequency (At 900 RPM)	120 cps

Auxiliary Generator

Rating	18 kW
Nominal Output Voltage (AC)	55
Rectified Output Voltage (DC)	74

Traction Motors

Model	D77
Number	4
Type	DC, Series Wound Axle Hung

GENERAL DATA (Cont'd)

Driving Wheels

Number	4 Pair
Diameter	40"

Air Compressor

Type	Two Stage
Number Of Cylinders	3
Displacement at 900 RPM	254 Cu. Ft./Min.
Cooling	Water
Lube Oil Capacity	10-1/2 Gal.

Storage Battery

Number Of Cells	32
Voltage	64
Rating - 8 Hour	284 Ampere Hour

Supplies

Engine Lubricating Oil Capacity	165 Gal.
With Deep Sump Oil Pan	258 Gal.
Cooling Water Capacity	230 Gal.
Sand Basic	35 Cu. Ft.
Special	40 Cu. Ft.
Fuel	
Basic	1100 Gal.
Special	1400 Gal.
Special	1600 Gal.

Major Dimensions

Track Gauge	4' 8-1/2"
Distance Between Coupler Pulling Faces	49' 2"
Maximum Height Over Rail	15' 0"
Maximum Width Over Underframe	10' 0-3/4"

GENERAL DATA (Cont'd)

Curve Negotiation

Truck swing limits single unit curve negotiation to a 54° or 110 ft. radius curve.

Two units coupled are limited by coupler swing to a 51° or 115 ft. radius curve.

Locomotive coupled to 50 ft. car is limited by car coupler swing to a 29° or 200 ft. radius curve.

TABLE OF NOMINAL SPEEDS

Gear Ratio	Minimum Continuous Speed At Full Power	Maximum Speed	Maximum Speed At Which Full Power Is Available	
			Basic No Shunt	1 Step Shunt
62:15	9.3	65*	31.8	65

*Based on rated RPM of traction motors.

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SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

The General Motors Model MP15AC multipurpose locomotive is equipped with a Model 645E diesel engine which drives the main generator. Electrical power from the main generator is distributed to four traction motors, each of which is directly geared to a pair of driving wheels.

The hood end of the locomotive is considered the front end, and the operator's controls are appropriately located. However, the locomotive operates equally well in either direction.

While each locomotive is an independent power source, several may be coupled together to form a consist. When coupled together for multiple unit operation, all units are simultaneously controlled from the single set of controls located in the cab of the lead unit. This is accomplished through jumper cables connected between the units. The end-to-end arrangement of units in a consist in no way affects operation.

HOW THE LOCOMOTIVE OPERATES

1. The fuel pump supplies fuel to the diesel engine injectors. During fuel priming, the electric motor driving the fuel pump uses current from the storage battery. After the engine starts, the motor uses current from the auxiliary generator.

2. The diesel engine is cranked by means of two electric starting motors. Power is supplied to the motors from the storage battery.

3. When the engine is running, it supplies mechanical power to drive two electric generators, the air compressor, a traction motor and generator blower, and engine mounted lube oil and cooling water pumps.

4. The auxiliary generator charges the storage battery and supplies low voltage direct current for the control and lighting circuits. The companion alternator furnishes power to the main traction alternator field, various electronic modules and transductors, and the radiator cooling fan.

5. The main traction alternator (main generator) converts the engine's mechanical power to high voltage AC electrical power. A power rectifier assembly converts the AC power to DC power which is then distributed to the traction motors.

6. By means of the cab controls, low voltage circuits are established to actuate the engine governor and electrical switchgear. This switchgear controls generator excitation and distribution of power to the traction motors.

7. Four traction motors are located under the locomotive. Each traction motor is directly geared to an axle and pair of driving wheels. These motors are located in two trucks which support the locomotive weight and distribute it to the driving wheels.

8. Operator control of engine speed and locomotive power is provided by the throttle. An engine speed governor, actuated by electrical signals from the throttle, maintains the specific engine speed associated with each throttle position. The main generator output power is controlled by the excitation and control system which maintains the specific power level associated with each throttle position.

9. Through most of the locomotive operating range, the load regulator maintains this specific power output. In the switching mode, the engine idle speed and main generator excitation are changed to provide the fast acceleration needed for yard switching operations.

10. The air compressor maintains reservoir air pressure to be used primarily for the air brakes. The air brakes are controlled by the operator through suitable equipment in the cab.

11. Except for manual operation of the cab controls, the locomotive operation is controlled automatically by the excitation and power control system. Various alarms and safety devices will alert the operator should any operating difficulties occur.

12. The excitation and power control system consists mainly of electronic components, most of which are mounted on plug-in circuit modules located in the control stand. Generally, each circuit module performs a specific function such as limiting the maximum current level to the main generator field.

CAUTION: Do not disengage any circuit modules or operate any test switches during locomotive operation.

Do not disengage the VR module unless the diesel engine is completely stopped.

SECTION 2

CONTROLS

INTRODUCTION

The control devices normally used during locomotive operation are located within the cab. The switch for fuel priming and engine cranking, however, is located at an equipment rack in the engineroom.

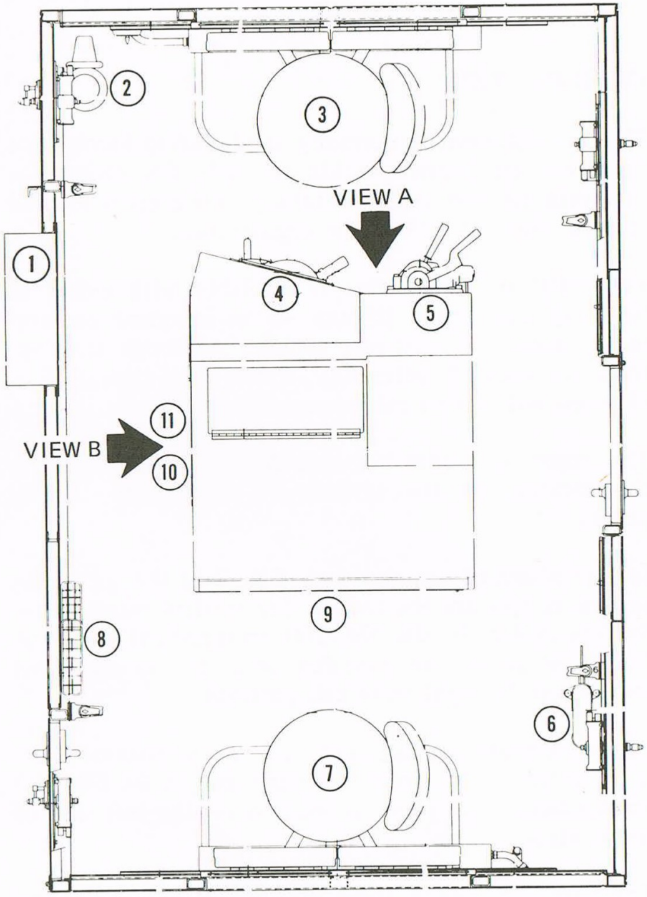
The MP15AC locomotive is available with either of two cab equipment layouts – the standard arrangement or the SW1200 arrangement. Although the controls are located differently, locomotive operation is identical with either cab arrangement.

The major difference between the two arrangements is the location of the instrument and engine control panels.

In the standard arrangement, Fig. 2-1, the air brake system gauges are located on the control stand above the controller. In the SW1200 arrangement cab, Fig. 2-2, these gauges are mounted on an instrument panel located on the right front cab partition.

In the standard arrangement, the engine control panel is mounted on the front cab partition. In the SW1200 arrangement, this panel is located on the left side of the control console.

The fuse and switch panel and circuit breaker panels are also at different locations on the control console.



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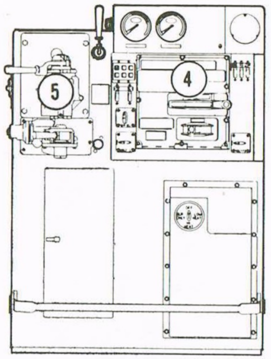

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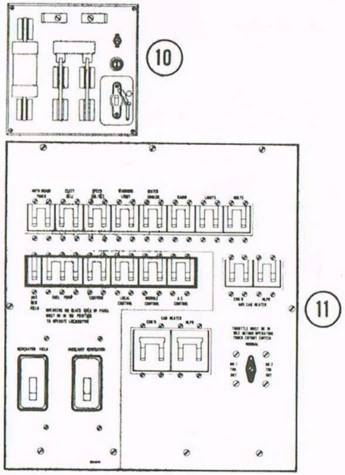
VIEW A



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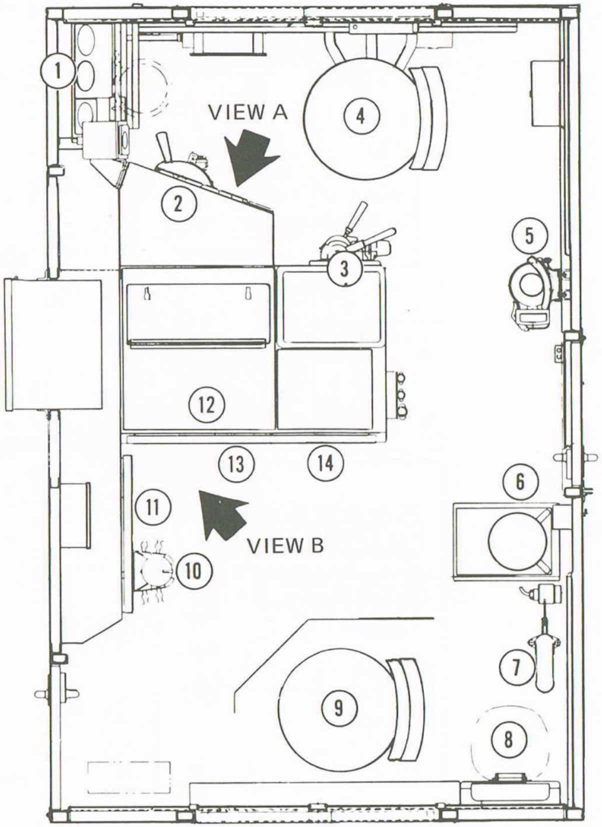
VIEW B

1. Engine Control Panel
2. Fire Extinguisher
3. Operator's Seat
4. Controller
5. Air Brake System
6. Emergency Brake Valve
7. Auxiliary Seat
8. Fusee Rack
9. Electronic Module Compartment
10. Fuse And Switch Panel
11. Circuit Breaker Panel

Fig. 2-1 – Cab Layout - Standard Arrangement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VIEW A
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VIEW B
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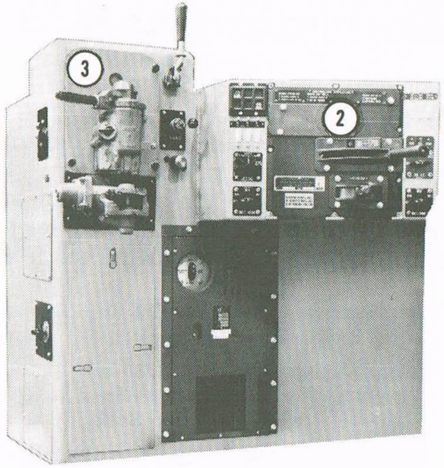
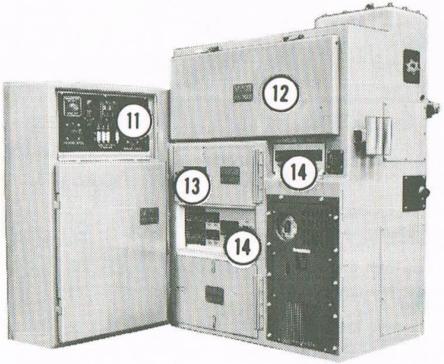


VIEW A


11
12
13
14
14
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VIEW B

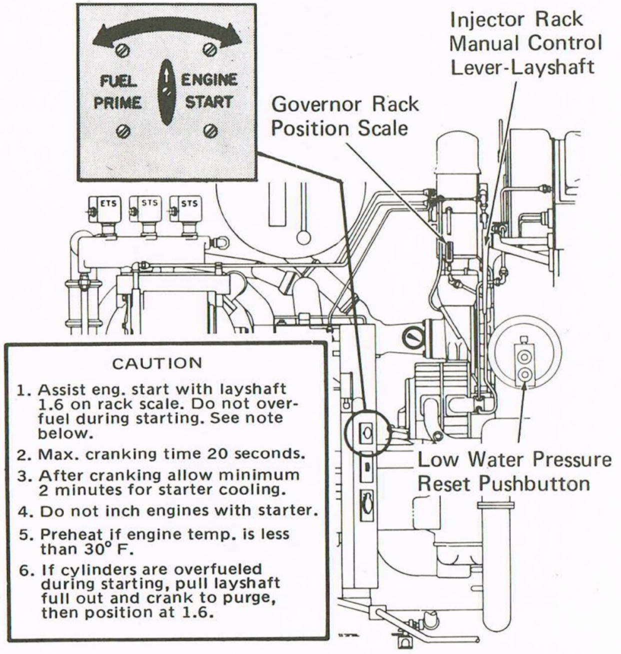
1. Instrument Panel
2. Controller
3. Air Brake System
4. Operator's Seat
5. Fire Extinguisher
6. Water Cooler
7. Emergency Brake Valve
8. Observer's Seat
9. Auxiliary Seat
10. Fusee Rack
11. Engine Control Panel
12. Electronic Module Compartment
13. Fuse And Switch Panel
14. Circuit Breaker Panels

Fig. 2-2 – Cab Layout - SW1200 Arrangement

ENGINE STARTING CONTROLS, Fig. 2-3

Fuel Prime And Engine Start Switch

This switch, located on the equipment rack in the engineroom, is a three position rotary switch used during engine starting. When attempting to start the diesel engine, the switch must first be set to and held in the FUEL PRIME position for 10 to 15 seconds.


FUEL
PRIME
ENGINE
START
Injector Rack Manual Control Lever-Layshaft
Governor Rack Position Scale
ETS
STS
STS
Low Water Pressure Reset Pushbutton

CAUTION

1. Assist eng. start with layshaft 1.6 on rack scale. Do not overfuel during starting. See note below.
2. Max. cranking time 20 seconds.
3. After cranking allow minimum 2 minutes for starter cooling.
4. Do not inch engines with starter.
5. Preheat if engine temp. is less than 30° F.
6. If cylinders are overfueled during starting, pull layshaft full out and crank to purge, then position at 1.6.

NOTE: If engine is equipped with purge control system, do not push layshaft until engine has cranked for six seconds. When cranking engine, position the layshaft lever at one third rack (approximately 1.6 on the scale). Do not advance lever to increase engine speed until oil pressure is confirmed.

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Fig. 2-3 – Engine Starting Controls

This energizes the fuel pump which then pumps fuel to the injectors. This fuel priming action also purges air bubbles from the fuel lines.

The START position of the switch is used to supply power from the storage battery to the starting motors which crank the engine.

Injector Rack Manual Control Lever

This engine mounted hand-operated lever operates the injector racks. It is used to position the injector racks during engine cranking, thereby providing an immediate supply of fuel to the cylinders.

Low Water Pressure Reset

If the engine cooling water pressure is low, this device will trip and dump governor oil pressure, causing the engine to shut down. The detector will often trip during engine starting, especially on starting after filling a completely drained system. It may also trip after starting a cold engine or one that has had cooling system pressure released. The detector should be reset soon after the engine starts and is idling.

FUSE AND SWITCH PANEL

The fuse and switch panel, Fig. 2-4, is located within the control console behind a latched door.

Starting Fuse

The starting fuse is in use only during the period that the diesel engine is actually being started. At this time, battery current flows through the fuse and starting contactor to the cranking motors.

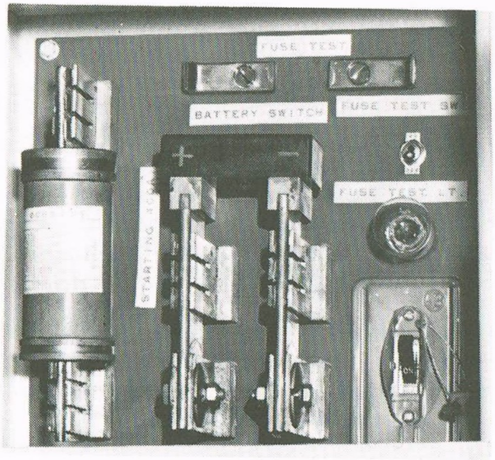

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Fig. 2-4 – Fuse And Switch Panel

Although this fuse should be in good condition and always left in place, it has no effect on locomotive operation other than for engine starting. A defective fuse can be detected when attempting to start the engine, since at that time (even though the starting contactors close) the cranking circuit is open.

CAUTION: The locomotive is equipped with series connected starting motors which require a 400 ampere starting fuse. Certain other model locomotives require an 800 ampere starting fuse. The two fuses are of the same physical size. Observe fuse panel marking. Do not use an incorrectly rated fuse.

Main Battery Knife Switch

This large double-pole single-throw knife switch is used to connect the battery to the locomotive low voltage system and should be kept closed at all times during operation.

This switch may be opened during certain shop maintenance procedures and in instances where the engine is shut down and the locomotive taken out of service for an extended layover. This will prevent the battery from being discharged in the event the lights or other low voltage devices are inadvertently left operating during the layover.

Fuse Test Equipment

A pair of test blocks, a test light, and a test light switch are provided for fuse testing. To test fuses, first set the test light switch to ON to ensure that the test light is not burned out. Return test switch to OFF. Place fuse across test blocks with metal ends in firm contact with blocks. If fuse is good, test light will come on. If fuse is burned out, test light will not come on. Always test fuses before installation, and isolate circuits in question by opening switches before replacing fuses.

Ground Relay Cutout Switch

The purpose of the ground relay cutout switch is to eliminate the ground protective relay from the locomotive circuits during certain shop maintenance inspections. It MUST ALWAYS BE KEPT CLOSED in normal operation. When this multiple pole toggle switch is open, it prevents excitation of the main generator and speedup of the diesel engine in addition to cutting out the ground protective relay.

CIRCUIT BREAKER PANEL -- STANDARD ARRANGEMENT CAB

This panel, Fig. 2-5, is located in the rear of the control console. The panel is divided into two sections, one containing those circuit breakers that must be in the ON position to operate the locomotive, and the second section containing those circuit breakers for lights and miscellaneous devices that are used as conditions require.

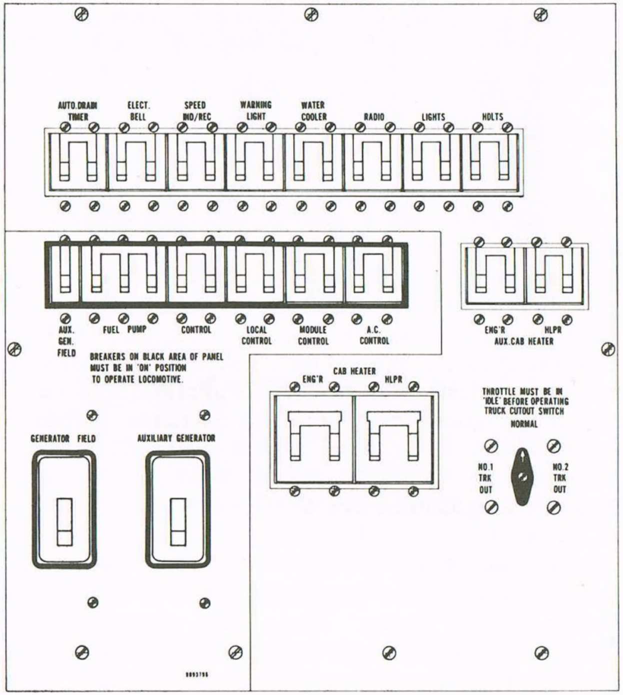
AUTO.DRAIN TIMER
ELECT. BELL
SPEED IND/REC
WARNING LIGHT
WATER COOLER
RADIO
LIGHTS
HOLTS
AUX. GEN. FIELD
FUEL PUMP
CONTROL
LOCAL CONTROL
MODULE CONTROL
A.C. CONTROL
ENG'R
HLPR
AUX.CAB HEATER
BREAKERS ON BLACK AREA OF PANEL MUST BE IN 'ON' POSITION TO OPERATE LOCOMOTIVE.
CAB HEATER
ENG'R
HLPR
THROTTLE MUST BE IN 'IDLE' BEFORE OPERATING TRUCK CUTOUT SWITCH
NORMAL
NO.1 TRK OUT
NO.2 TRK OUT
GENERATOR FIELD
AUXILIARY GENERATOR

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Fig. 2-5 – Circuit Breaker Panel - Standard Arrangement Cab

CIRCUIT BREAKERS REQUIRED ON FOR LOCOMOTIVE OPERATION

AUX GEN FIELD Circuit Breaker

The field excitation circuit of the auxiliary generator is protected by this circuit breaker. In the event that this circuit breaker trips, it stops auxiliary generator output to the low voltage system and also stops fuel pump operation. An alternator failure (NO POWER/CHRG) alarm occurs. The engine will go to idle speed and then stop from lack of fuel.

FUEL PUMP Circuit Breaker

This three pole circuit breaker protects the fuel pump motor circuit. A fuel filter bypass valve is provided to prevent overloading the fuel pump motor if the fuel filter becomes clogged.

CONTROL Circuit Breaker

This circuit breaker sets up the fuel pump and control circuits for engine starting. Once the engine is running, power is supplied through this circuit breaker from the auxiliary generator to maintain operating control.

LOCAL CONTROL Circuit Breaker

This circuit breaker establishes "local" power from the auxiliary generator to operate heavy duty switchgear and various control devices.

MODULE CONTROL Circuit Breaker

Electrical control circuits are assembled on plug-in circuit modules to facilitate maintenance. Local control power is supplied to many of the circuit boards. This circuit breaker protects the local control circuit to the boards.

AC CONTROL Circuit Breaker

The D14 alternator is the power supply for various excitation and control devices. This circuit breaker is employed to protect the circuitry. The No AC Voltage relay NVR is also located in this circuit. If the circuit breaker trips during locomotive operation, the NO POWER/CHRG alarm will occur.

GENERATOR FIELD Circuit Breaker

The AR10 generator receives its excitation through a pair of slip rings connected to the D14 alternator output through a controlled rectifier. This circuit breaker is provided to protect the controlled rectifier and the generator field windings.

AUXILIARY GENERATOR Circuit Breaker

This circuit breaker connects the auxiliary generator to the low voltage system. It protects against excessive current demands. Should the circuit breaker trip, it stops auxiliary generator output to the low voltage system and also stops fuel pump operation. An alternator failure (no power) alarm would then occur. The engine will go to idle speed and then stop from lack of fuel.

MISCELLANEOUS CIRCUIT BREAKERS

CAB HEATER Circuit Breakers (4)

Protect the circuits to the blower motors in the cab heaters.

HDLTS Circuit Breaker

This circuit breaker protects the headlight circuits. It must be ON to provide current to the front headlight circuit and through the trainline to the light at the rear of a consist.

LIGHTS Circuit Breaker

This circuit breaker must be ON to supply power for the individual switches provided for number, class, platform, cab, controller, and ground and gauge lights.

RADIO Circuit Breaker

Protects radio circuits.

WATER COOLER Circuit Breaker

When an electric water cooler is provided, this circuit breaker protects the circuit.

AUTO. DRAIN TIMER Circuit Breaker

On units equipped with automatic timed blowdown of the compressed air system air drains, this circuit breaker protects the timing device and the drain solenoids.

Miscellaneous Circuit Breakers

Circuit breakers can be provided for protection of various other extra equipment such as safety and warning devices. These circuit breakers should be operated when required.

Motor Cutout Switch

This three-position switch is placed in the NORMAL position during normal locomotive operation. The switch is to be placed in the NO. 1 or NO. 2 TRK. OUT position only in an emergency or if the locomotive is to be run in the maintenance shop.

Do not attempt to move cars with one of the trucks cut out, as serious damage to the electrical equipment may result.

Do not operate at more than one-half throttle with one truck cut out.

WARNING: The WHEEL SLIP indicator lights during operation with one truck cut out. Do not operate with a truck cut out unless it is absolutely certain that all of the wheels are free to rotate.

CIRCUIT BREAKER PANELS -- SW1200 ARRANGEMENT CAB

In the SW1200 arrangement cab, circuit breakers are located on three separate panels, Fig. 2-6. Refer to Fig. 2-2 for locations of these panels within the control console. The functions of the circuit breakers on these three panels are identical to those in the standard arrangement cab. Refer to the preceding paragraphs for circuit breaker and motor cut-out switch descriptions.

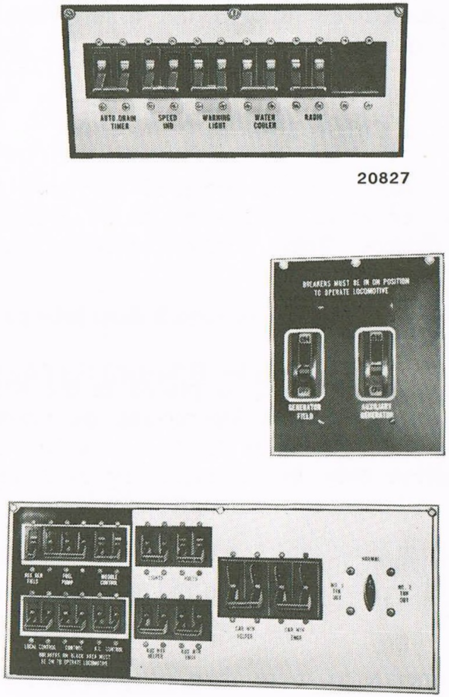
AUTO DRAIN TIMER
SPEED IND
WARNING LIGHT
WATER COOLER
RADIO
BREAKERS MUST BE IN ON POSITION TO OPERATE LOCOMOTIVE
GENERATOR FIELD
AUXILIARY GENERATOR
FUEL PUMP
LOCAL CONTROL
CONTROL
NORMAL
NO. 1 TRK OUT
NO. 2 TRK OUT

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Fig. 2-6 – Circuit Breaker Panels – SW1200 Arrangement Cab

ENGINE CONTROL PANEL

The engine control panel, Fig. 2-7, is located at the front of the cab below the center windows. Refer to Fig. 2-1 or Fig. 2-2 for exact location based on locomotive cab arrangement. This panel contains various switches and alarm lights. Since all of these items will be used at one time or another during operation, a brief description of their individual functions is provided.

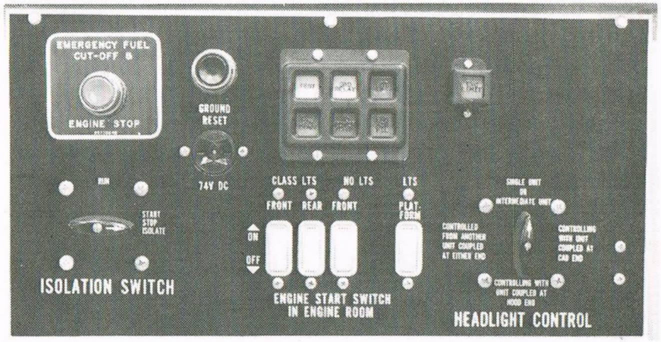
EMERGENCY FUEL CUT-OFF &
ENGINE STOP
GROUND RESET
74V DC
RUN
START
STOP
ISOLATE
ISOLATION SWITCH
CLASS LTS
NO LTS
LTS
FRONT
REAR
FRONT
PLAT-FORM
ON
OFF
ENGINE START SWITCH IN ENGINE ROOM
SINGLE UNIT OR INTERMEDIATE UNIT
CONTROLLED FROM ANOTHER UNIT COUPLED AT EITHER END
CONTROLLING WITH UNIT COUPLED AT CAB END
CONTROLLING WITH UNIT COUPLED AT HOOD END
HEADLIGHT CONTROL

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Fig. 2-7 – Engine Control Panel

Note that an alarm bell accompanies alarm signal light indications. On units connected for multiple unit operation, the alarm bell rings in all units of a consist, but the alarm light will come on only in the affected unit.

Press-to-test indicating lights are used to provide a lamp test capability. To test a particular lamp, merely apply finger pressure to that lens cap. A small time delay, possibly up to one second, will occur before the indicating light comes on.

TEST Light

The TEST light comes on when the test panel rotary TEST SWITCH is placed in the LOAD TEST or CIRCUIT CHECK position. The light indicates that the locomotive circuits are set up for either load testing when the reverser handle is centered or for circuit check with the generator field circuit breaker open.

GRD RELAY Light

This light indicates that an electrical path to ground has occurred, or that a group of five diodes in the main generator has failed. When the light comes on and the alarm sounds, the operator should wait 10 seconds, then press the GROUND RESET pushbutton. Power will then reapply. It is not necessary to isolate the unit, nor is it necessary to have the throttle in IDLE while pressing the button.

If there is no GROUND RESET pushbutton the locomotive will be equipped with special automatic ground relay reset, and the operator need take no action to reset the relay. Such automatic reset devices are equipped for lockout, and automatic reset will be nullified after either a specific number of trips or after a given number of trips within a time period. On the basic locomotive, when the ground relay alarm occurs for the third time after using the GROUND RESET button twice, the affected unit should be isolated.

CAUTION: Always report ground relay light indications to proper maintenance personnel.

HOT ENG Light

This light operates in conjunction with the alarm bell to warn the operator that engine cooling water has reached an excessive temperature. When the light is on, engine speed and power are automatically reduced until the hot engine condition is corrected. If the cooling system has failed, a hot lubricating oil detector will shut the engine down before serious engine damage occurs. If hot engine shutdown occurs do not attempt to restart the engine.

GOV DOWN Light

This light comes on when the engine governor has shut the engine down for one of the following reasons.

1. True low oil pressure.
2. Hot engine oil.
3. Low cooling water pressure.
4. Crankcase (oil pan) overpressure.

A mechanism to detect low engine lubricating oil pressure is built into the engine governor. This mechanism is actuated by true oil pressure failure or by dumping oil from the engine oil line leading to the governor. In either event a small button will pop out of the governor body, indicating that the mechanism has tripped the low oil alarm switch. The light on the engine control panel will come on to indicate that the low oil mechanism has tripped.

When a governor shutdown indication occurs, it is necessary to determine whether the crankcase pressure-low water pressure detector has tripped to dump engine oil from the line leading to the governor, or whether a true oil failure has occurred. This can be determined by checking the crankcase pressure-low water pressure detecting device, Fig. 3-2, for protruding reset buttons. A protruding upper button indicates excessive oil pan pressure; a protruding lower button indicates low water pressure.

WARNING: When it is determined that the crankcase pressure detector has tripped, make no further engine room inspections. Do not attempt to restart the engine. Isolate the unit and drain the cooling system in accordance with railroad regulations.

If neither the crankcase pressure nor the low water pressure detector has tripped, and engine oil level is satisfactory with a hot engine condition apparent, do not attempt to restart the engine. Report engine shutdown circumstances to authorized maintenance personnel.

NO POWER/CHRG Light

This light will come on and the alarm bell will sound whenever D14 alternator output stops – normally at engine shutdown. The indication can also be caused by true D14 failure or failure of the auxiliary generator. A tripped AC CONTROL circuit breaker will also bring about the indication. In each case the locomotive will fail to deliver power.

ENG AIR FIL Light

This indicator comes on when the engine filter switch detects a high pressure drop across the fiberglass engine air filters. This indicates that the filters are dirty and require changing.

Locomotive operation may continue, however, the indication should be reported to the proper maintenance personnel.

EXC LIMIT Light

This light indicates that the excitation limit (EL) module is operating to prevent main generator field current from exceeding a safe value. Since the EL module is a backup system, this light indicates that the generator excitation module (GX) may have failed. If the light goes out and stays out, the overexcitation condition was temporary and normal locomotive operation may continue. If the light continues to cycle on and off, the locomotive will operate. However, power regulation is very rough and undesirable wear on the generator field contactor will occur. This condition should be corrected as soon as possible.

EMERGENCY FUEL CUT-OFF AND ENGINE STOP Pushbutton

This switch on the engine control panel is wired in series with emergency fuel cutoff switches located at the fuel filler openings. Pressing any one of the pushbuttons will cause the engine to stop immediately. The switches are spring loaded and do not need to be reset.

The switch operates to stop only the engine in the unit in which the switch is located. In an emergency if it is necessary to stop all engines in a multiple unit consist, pull out on the throttle lever and position it fully to the right.

GROUND RESET Pushbutton

The ground relay detects low voltage grounds during engine start and high voltage grounds during operation under power. When it trips, the alarm bells ring in all units of a consist. On the unit affected, generator excitation is lost, the diesel engine goes to idle speed, and the GRD RELAY light comes on.

To reset the ground relay and restore locomotive power, wait 10 seconds and press the GROUND RESET pushbutton. It is not necessary to isolate the unit nor is it necessary to place the throttle in IDLE position before pressing the pushbutton unless the locomotive is at a standstill.

Repeated resetting of the ground relay is permissible, but instructions as issued by the railroad regarding repeated resetting must be followed. However, in the absence of definite instructions to the contrary, isolate a unit when the GRD RELAY light comes on for the third time after resetting.

CAUTION: Always report ground relay light indications to proper maintenance personnel.

ISOLATION SWITCH

This switch has two positions, one labeled START/STOP/ISOLATE, the other labeled RUN. The functions of these two positions are as follows:

1. START/STOP/ISOLATE position

   The switch is placed in this position whenever the diesel engine is to be started. The FUEL PRIME/ENGINE START switch is effective only when the ISOLATION SWITCH is in this position.

   The START position is also used to isolate the unit, and when isolated the unit will not develop power nor respond to the controls. In this event the engine will run at idle speed regardless of throttle position. This position will also silence the

   alarm bell in the event of a no power or low lube oil alarm. It will not, however, stop the alarm in the event of a hot engine.

   This switch must be placed in the ISOLATE position before the traction motor cut-out switch can be operated.

2. RUN Position

   After the engine has been started, the unit can be placed "on the line" by moving the isolation switch to the RUN position. The unit will then respond to control and will develop power in normal operation.

Miscellaneous Switches

Switches are included in circuits for various lights and devices on the locomotive. The switches are closed as desired to operate the class lights, the number lights, and the platform lights.

HEADLIGHT CONTROL Switch

The twin sealed-beam front and rear headlights are controlled by the front and rear headlight switches on the locomotive control stand. Before these switches will function, the headlight circuit breaker must be placed ON.

In a multiple unit consist, the HEADLIGHT CONTROL switch provides for operation of the trailing unit headlights from the lead unit. The switch positions are set on each unit as follows:

1. On Lead Unit

   If only a single locomotive unit is being used, place the switch in SINGLE UNIT OR INTERMEDIATE UNIT position.

In multiple unit service, if trailing units are coupled to the No. 2 or long hood end of the lead unit, place the switch in the CONTROLLING WITH UNIT COUPLED AT HOOD END position.

In multiple unit service, if trailing units are coupled to the No. 1 or short hood end of the lead unit, place switch in CONTROLLING WITH UNIT COUPLED AT CAB END position.

2. On Intermediate Units

   On units operating in between other units in a multiple unit consist, place the switch in the SINGLE UNIT OR INTERMEDIATE UNIT position.

3. On Trailing Units

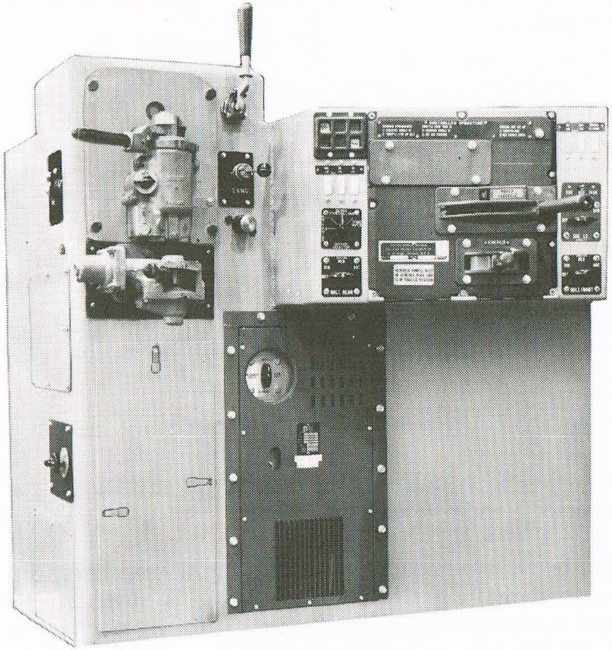
   The last unit in a multiple unit consist should have the switch placed in the CONTROLLED FROM ANOTHER UNIT COUPLED AT EITHER END position.

OPERATOR'S STATION CONTROLS, Fig. 2-8

The switches and handles normally used during locomotive operation are described in the following paragraphs.

Throttle Handle

The throttle handle, Fig. 2-9, actuates switches within the controller to establish low voltage electrical circuits to the engine governor and to related auxiliary relays for purposes of controlling engine speed and power. It is moved from right to left to increase engine speed and power.



20830

Fig. 2-8 – Operator's Station Controls

The throttle has nine detent positions; IDLE, and 1 through 8 plus a STOP position, which is obtained by pulling the handle outward and moving it to the right beyond IDLE to stop all engines in a locomotive consist. The throttle can not be moved when the reverser handle is centered and removed from the controller.

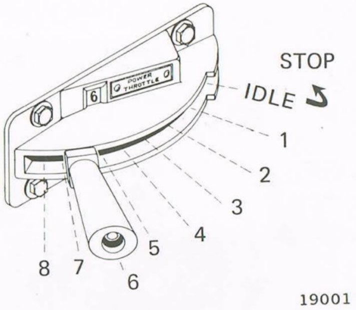


Fig. 2-9 – Throttle Handle

Reverser Handle, Fig. 2-10

The reverser handle has three detent positions; left, centered, and right. When the handle is moved to the right toward the hood end of the unit, circuits are set up for the locomotive to move in that direction. When the handle is moved to the left, the locomotive will move in that direction when power is applied. With the reverser handle centered, the throttle handle can be moved to increase engine speed; however, power will not be applied to the traction motors.

The reverser handle is centered and removed from the panel to lock the throttle in IDLE position.

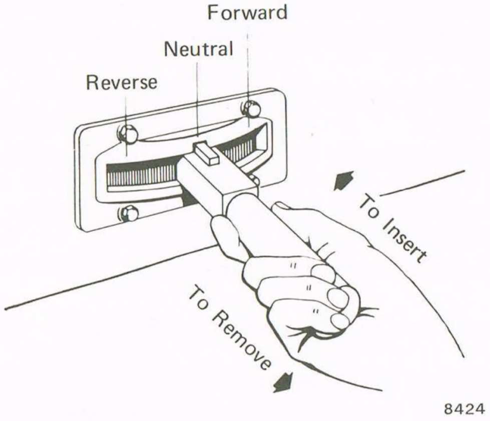


Fig. 2-10 – Reverser Handle

Mechanical Interlocks On Controller

The handles on the controller are interlocked so that with:

1. Throttle in IDLE position –

   Reverser handle can be moved to any position and removed from the controller when the handle is centered.

2. Throttle handle in position 1 through 8 --

   Reverser handle position cannot be changed.

3. Throttle handle in STOP position --

   Reverser handle can be moved to any position, but cannot be removed from the controller.

4. Reverser handle in forward or reverse position –

   Throttle handle can be moved to any position.

5. Reverser handle in neutral position --

   Throttle handle can be moved to any position.

6. Reverser handle removed from controller –

   Throttle handle cannot be moved.

Control And Operating Switches, Fig. 2-11

A group of three operating switches is located at the upper right corner of the control console. They snap into the on position when moved upward. The switches must be on (up) in the lead unit of a locomotive consist, and must be off (down) in trailing units.

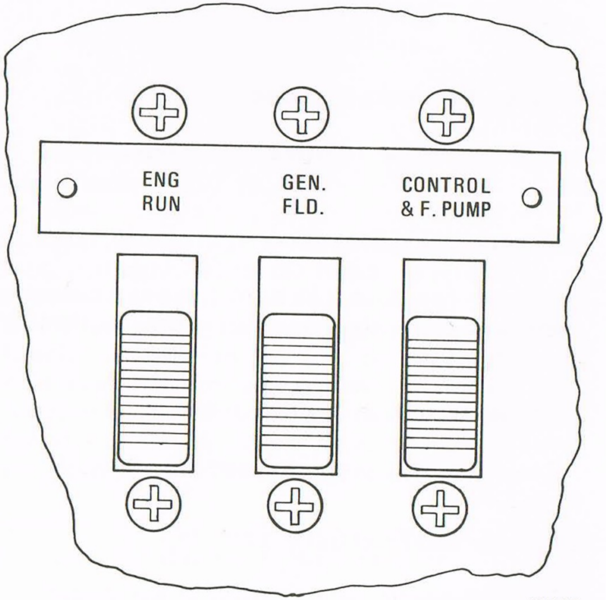


Fig. 2-11 – Control And Operating Switches

1. CONTROL & F. PUMP Switch

   The control and fuel pump switch provides power to various low voltage control circuits. The switch must be on to start the engine and operate the fuel pump.

2. GEN. FLD. Switch

   The generator field switch must be on to obtain power from the locomotive.

3. ENG RUN Switch

   The engine run switch must be on to obtain control of engine speed.

Headlight Switches

Two four-position rotary snap switches are provided for independent control of the front and rear headlights. Each switch has OFF, DIM, MED, and BRT positions. All positions of each switch are operative, but in a multiple unit consist, the headlight control switches on the engine control panels of each unit in a consist must be properly positioned, and only the lead unit controls the headlights.

For these switches to function, the headlight circuit breaker must be on.

Heater Switch

The engineer's heater is controlled by this four-position rotary switch. The positions are OFF, LOW HEAT, HI HEAT, and BLR ONLY (blower only).

An identical switch for the helper's heater is located at the rear of the control console at the helper's station. Circuit breakers for the two heaters are located on the circuit breaker panel.

SERVICE SELECTOR Switch

This rotary snap switch is provided to select the type of locomotive service required. The switch has four positions; SWITCHING 1, SWITCHING 2, SERIES (FORESTALLING), and ROAD (AUTO). The functions of the various positions are as follows:

SWITCHING 1 Position

This is the normal position for yard switching. The load regulator is in maximum field position at locomotive start and the generator excitation circuit is set up to provide fast but controlled throttle response for switching operations.

SWITCHING 2 Position

Locomotive operation in the SWITCHING 2 position is the same as in SWITCHING 1 position except that the engine idles faster in SWITCHING 2 position. The faster idle results in faster acceleration. This position may be used when fast acceleration is desired, such as when "kicking" cars.

SERIES (FORESTALLING) Position

The traction motors on this locomotive are connected in permanent series-parallel with the main generator. However, traction motor field shunting is provided as an option for use during high speed road operation.

The purpose of the SERIES (FORESTALLING) switch position is to prevent field shunting during slow speed heavy drag service where undesirable cycling of the shunting contactors might occur.

During multiple unit operation, this position also prevents transition or field shunting from occurring on trailing units of the consist.

This switch position also sets up generator excitation circuitry to provide a smooth application of power for a softer start during road service.

ROAD (AUTO) Position

The ROAD (AUTO) position is used during moderate and high speed road operation. Throttle response is the same as during SERIES (FORESTALLING) operation. The generator excitation circuits are set up to provide the smooth application of power.

The only difference between SERIES and ROAD operation is that in ROAD operation, field shunting is allowed to occur when the "transition" speed is reached. During multiple unit operation, field shunting or transition is also allowed on those trailing units so equipped.

Miscellaneous Switches

Switches for various lights, such as ground and gauge lights are provided at the left side of the controller. The lights are on when the switches are in the up position.

Indicating Lights Panel

This assembly is located adjacent to the upper left corner of the controller. The purpose of the assembly is to provide a visual warning of operating difficulties. The unit has provisions for four press-to-test lights covered by either white or colored lens caps identified by black block letters.

The WHEEL SLIP indicating light is provided on the basic locomotive; however, three other indicating lights may be provided as extras. These may be PCS OPEN, SAND, OSC HDLT, or other optional equipment indicating lights. The functions of these lights are described in the following paragraphs.

WHEEL SLIP Light

Intermittent flashing of the WHEEL SLIP light indicates that the wheel slip control system is doing its job and is correcting the slips. The throttle and locomotive power should not be reduced unless severe lurching threatens to break the train.

WARNING: A WHEEL SLIP light flashing persistently or burning continuously may indicate a pair of sliding wheels or circuit difficulty. Stop the locomotive and make a careful inspection to ascertain that there are no locked sliding wheels.

PCS OPEN Light

The PCS or pneumatic control switch functions to automatically reduce locomotive power in the event that an emergency or safety control air brake application occurs. It does so by reducing the speed of all engines to idle.

CAUTION: The engine run switch should be in the off position in all trailing units, or (depending on the type and position of locomotives in the consist) it is possible that the PCS switch of the lead unit will not act to reduce engine speeds to idle.

When the switch is tripped, the PCS OPEN indicating light on the controller will come on. This light is

extinguished and locomotive power restored by resetting the PCS switch. This occurs automatically, provided that:

1. Control of the air brake is recovered.

2. The throttle is returned to IDLE position.

SAND Light

This extra light indicates that the manual sanding switch is positioned for sanding.

OSC HDLT

This extra light indicates that the optional red oscillating headlight is operating.

Air Horn Lever

When this operating lever is pulled down, compressed air is supplied to the air horn.

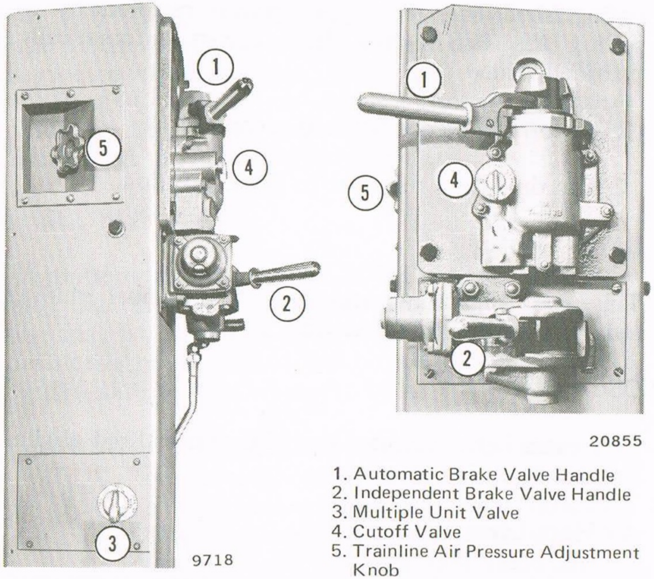
Bell Ringer

When the bell ringer is pressed, compressed air is directed to the locomotive warning bell operator.

AIR BRAKE EQUIPMENT

Basic locomotives are equipped with type 26NL air brakes. Since type 26NL is standard equipment, only that type of air brake will be discussed in this manual.

The 26NL air brake control equipment is located to the left of the controller. As shown in Fig. 2-12, this equipment consists of an automatic brake valve, independent brake valve, multiple unit valve (when MU control is installed), cutoff valve and a trainline



1. Automatic Brake Valve Handle
2. Independent Brake Valve Handle
3. Multiple Unit Valve
4. Cutoff Valve
5. Trainline Air Pressure Adjustment Knob

Fig. 2-12 – 26NL Air Brake Control Equipment

air pressure adjustment device. The dead engine fixture, also a part of the 26NL equipment is shown in Fig. 2-13. The unit is accessible from outside the locomotive through a side door.

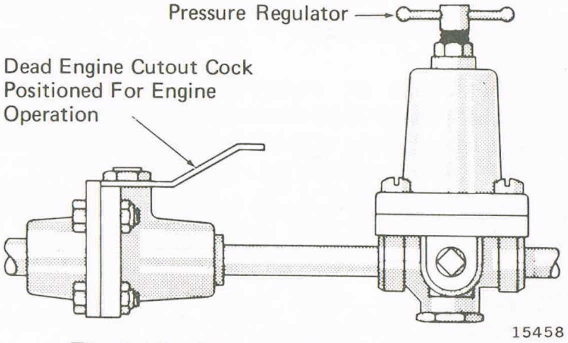


Fig. 2-13 – Dead Engine Cutout Cock And Pressure Regulator

Automatic Brake Valve, Fig. 2-14

The automatic brake valve handle may be placed in any of six operating positions.

Independent Brake Valve, Fig. 2-15

The independent brake valve handle is located directly below the automatic brake valve handle. It has two positions; namely, release and full application. Between these two positions is the application zone. Since this is a self-lapping brake, it automatically laps off the flow of air and maintains brake cylinder pressure corresponding to the position of the handle in the application zone.

Pressing the independent brake valve handle down when in the release position causes release of any automatic brake application existing on the locomotive.

Multiple Unit Valve (When Provided)

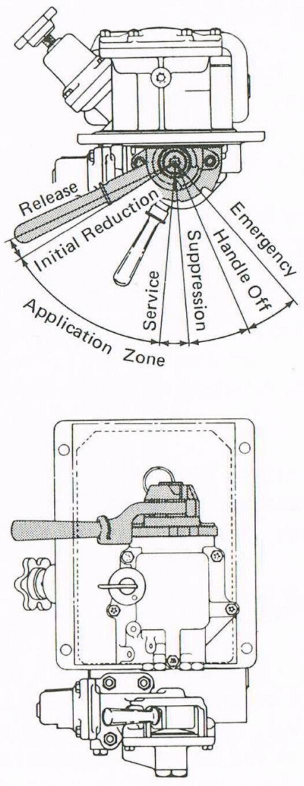
The multiple unit (MU-2) valve is located on the left-hand side of the control console, as shown in Fig. 2-12. Its purpose is to pilot the F1 selector valve which is a device that enables the air brake equipment of one locomotive unit to be controlled by that of another unit.

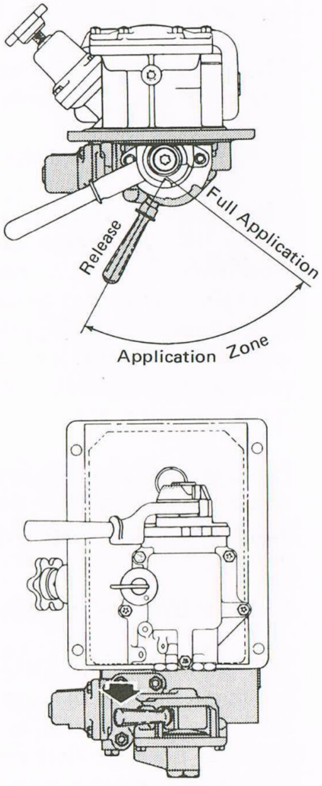
The basic MU-2 valve has three positions which are:

1. LEAD or DEAD
2. TRAIL 6 or 26*
3. TRAIL 24

The valve is positioned by pushing in and turning to the desired setting.

*Whenever the MU-2 valve is in the TRAIL 6 or 26 position, and if actuating trainline is not used, then


Release
Initial Reduction
Application Zone
Service
Suppression
Handle Off
Emergency
20901


Release
Full Application
Application Zone
20902

Press Handle Down To Release Automatic Application Of Locomotive Brakes

Fig. 2-14 -- Automatic Brake Valve Handle Positions

Fig. 2-15 -- Independent Brake Valve Handle Positions

the actuating end connection cutout cock must be opened to atmosphere. This is necessary to prevent the inadvertent loss of air brakes due to possible pressure buildup in the actuating line.

Cutoff Valve

The cutoff valve is located on the automatic brake valve housing directly beneath the automatic brake valve handle. The basic cutoff valve has the following three positions.

1. OUT
2. FRT (Freight)
3. PASS (Passenger)

Trainline Air Pressure Adjustment Knob

The trainline air pressure adjustment knob is located behind the automatic brake valve at the upper portion of the control console. With the automatic brake valve handle in release position, it is used to obtain the brake pipe pressure desired. The automatic brake valve will maintain the selected pressure against overcharge or leakage.

BRAKE EQUIPMENT POSITIONS

When operating locomotives equipped with 26NL air brakes, the brake equipment should be positioned according to the information given in Fig. 2-16.

Type Of Service	Automatic Brake Valve	Independent Brake Valve	Cutoff Valve	Dead Engine Cutout Cock	26D Control Valve	26F Control Valve	MU2 Valve	Overspeed Cutout Cock	Deadman Cutout Cock	6 NR Dist. Valve
SINGLE LOCOMOTIVE EQUIPMENT										
Lead	Release	Release	Passenger Freight	Closed				Open	Open	
Double Heading	Suppression	Release	Cutout	Closed				Open	Open	
Shipping Dead In Train	Handle Off Position	Release	Cutout	Open	Relief Valve At Control Reservoir 73 ± 2 Lbs.			Closed	Closed	Safety Valve 68 psi Setting
MULTIPLE LOCOMOTIVE EQUIPMENT AND EXTRAS										
Lead	Release	Release	Passenger Freight	Closed		Graduated	Lead	Open	Open	
Trail	Handle Off Position	Release	Cutout	Closed		Graduated Direct	*Trail 6 or 26 Trail 24	Open	Open	
Shipping Dead In Train	Handle Off Position	Release	Cutout	Open	Relief Valve At Control Reservoir 73 ± 2 Lbs.	Direct Release	Dead	Closed	Closed	Safety Valve 68 psi Setting
Double Heading	Handle Off Position	Release	Cutout	Closed		Graduated Direct	Lead	Open	Open	
Dual Control:										
Operative Station	Release	Release	Passenger Freight	Closed		Graduated Direct	Lead	Open	Open	
Non-Operative Station	Handle Off Position	Release	Cutout							

*Whenever the MU2A valve is in "Trail 6 or 26" Position and if the actuating train line is not used, then the actuating end connection cutout cock must be open to atmosphere; so as to prevent the inadvertent loss of air brakes due to possible pressure buildup in the actuating train line.

NOTE: By AAR standard all cocks in the brake system except brake pipe end cocks have handles perpendicular to pipe when open.

20903

Fig. 2-16 – Brake Equipment Positions

Air Pressure Gauges

Two air pressure gauges indicating main reservoir air pressure as well as various pressures associated with the air brakes are located at the operator's station. In the standard arrangement cab, these gauges are mounted in the control console above the controller. In the SW1200 arrangement cab, these gauges are mounted on the instrument panel located on the right front cab partition.

Load Current Indicating Meter (Optional Extra)

The locomotive pulling force is indicated by the load current indicating meter located alongside the air brake system pressure gauges. This meter is graduated to read amperes of electrical current, with 1500 being the maximum reading on the scale. On special order the meter may be color coded to indicate operating time limits at various meter pointer positions.

The meter is connected so as to indicate the current flowing through No. 3 and 4 traction motors. Since the amperage is the same in all motors, each motor will carry the amount shown on the meter.

SECTION 3

OPERATION

INTRODUCTION

This section of the manual covers recommended procedures for operation of the locomotive. The procedures are briefly outlined and do not contain detailed explanations of equipment location or function.

The information in this section is arranged in sequence, commencing with inspections in preparation for service, and with instructions for starting the engine, handling a light locomotive, coupling to train, and routine operating phases. The various operating situations and special features are also covered.

PREPARATION FOR SERVICE

GROUND INSPECTION

Check locomotive exterior and running gear for:

1. Leakage of fuel oil, lube oil, water or air.
2. Loose or dragging parts.
3. Proper hose connections between units in multiple.
4. Proper positioning of all angle cocks and shut-off valves.
5. Air cut in to truck brake cylinders.
6. Satisfactory condition of brake shoes.
7. Adequate supply of fuel.

8. Proper installation of control jumper cables between units.

LEAD OR SINGLE UNIT CAB INSPECTION

On lead or control unit, the control locations described in Section 2 should be checked and the equipment positioned for operation as follows:

Fuse And Switch Panel

1. Main battery switch closed.
2. Ground relay switch closed.
3. Starting fuse installed and in good condition.

Circuit Breaker Panel(s)

1. All breakers in black area of panel on.
2. GENERATOR FIELD and AUXILIARY GENERATOR circuit breakers on.
3. Lights circuit breakers and miscellaneous circuit breakers on as needed.
4. Traction motor cutout switch in NORMAL position.

Engine Control Panel

1. ISOLATION SWITCH in START position.
2. HEADLIGHT CONTROL switch in proper position for lead unit operation.
3. Miscellaneous switches on as required.

Locomotive Controller

The controller switches and operating handles should be positioned as follows:

1. Place CONTROL & F. PUMP switch in on (up) position.
2. Place ENG RUN and GEN FLD. switches in off (down) position.
3. Make sure throttle remains in IDLE position and reverser handle is removed from controller.
4. SERVICE SELECTOR switch in position for desired mode of operation; SWITCHING 1, SWITCHING 2, SERIES, or ROAD.
5. Lights switches on as required.

Air Brakes -- Type 26NL

1. Insert automatic brake valve handle (if removed) and place in suppression position. This will nullify the application of any safety control equipment used.
2. Insert independent brake valve handle (if removed) and move to full application position.
3. Place cutoff valve in the cut-in (FRT or PASS) position.
4. Place MU valve in LEAD position.

ENGINEROOM INSPECTION

The engine can be readily inspected by opening the access doors along the side of the hood end of the locomotive.

1. Check air compressor for proper lubricating oil supply.
2. Observe for proper water level on tank sight glass.
3. Check all valves for proper positioning.
4. Observe for leakage of fuel oil, lubricating oil, water or air.

ENGINE INSPECTION

The engine should be inspected before as well as after starting. After inspection and engine start, all engine-room doors should be closed and latched securely.

1. Check to see that engine overspeed lever is set, Fig. 3-1.

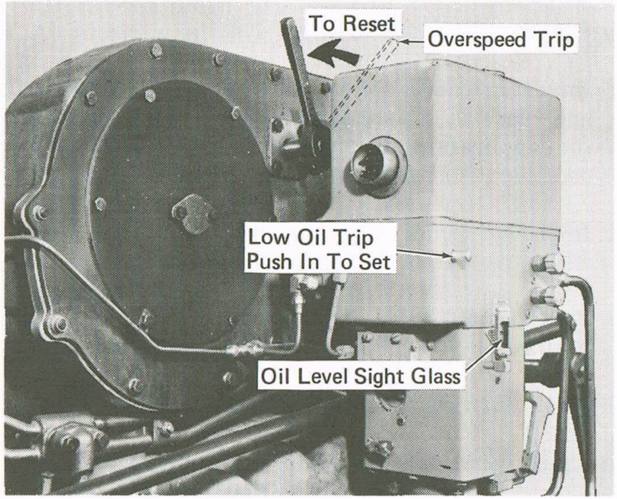

To Reset
Overspeed Trip
Low Oil Trip
Push In To Set
Oil Level Sight Glass
15840

Fig. 3-1 – Engine Overspeed Trip And Low Oil Pressure Trip Plunger

2. Observe that governor low oil pressure trip plunger, Fig. 3-1, is set and that there is oil visible in the governor sight glass.
3. Observe that the crankcase (oil pan) pressure and low water pressure detector reset buttons, Fig. 3-2, are set (pressed in). If the buttons protrude, press and hold for 5 seconds.
4. Observe that engine top deck, air box and oil pan inspection covers are in place and are securely closed.
5. Check that engine oil is at proper level on the dipstick and that lube oil strainer is full of oil (open square cover).

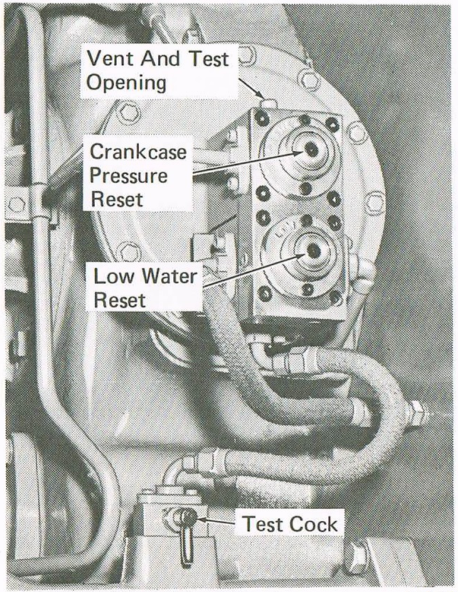

Vent And Test Opening
Crankcase Pressure Reset
Low Water Reset
Test Cock
20151

Fig. 3-2 – Low Water Pressure And Crankcase (Oil Pan) Pressure Detector

STARTING THE DIESEL ENGINE

After the preceding inspections have been completed, the diesel engine may be started. Starting controls are located at the accessory end of the engine in the area of the equipment rack. See Fig. 2-1.

NOTE: Preheat if engine temperature is less than 30° F.

Prelubricate if engine has been shut down for more than 48 hours.

Perform the following:

1. Open cylinder test valves and bar over the engine at least one revolution, observe for leakage from test valves. Close the test valves.

CAUTION: Make certain that the starting fuse is installed, in good condition, and of the correct rating as indicated on the panel.

2. Verify that the main battery switch is closed, and that the ground relay switch is closed.

3. Check that all circuit breakers in the black area of the circuit breaker panel are in the on (up) position.

4. Check that the CONTROL & F. PUMP switch on the control console is in the on (up) position.

5. Check that the ENG RUN and GEN FLD. switches on the control console are in the off (down) position.

6. Check that the ISOLATION switch on the engine control panel is in the START position.

7. At the equipment rack in the engine room, place the FUEL PRIME/ENGINE START switch in the PRIME position until fuel flows in the return fuel sight glass clear and free of bubbles (normally 10 to 15 seconds). See Fig. 3-3.

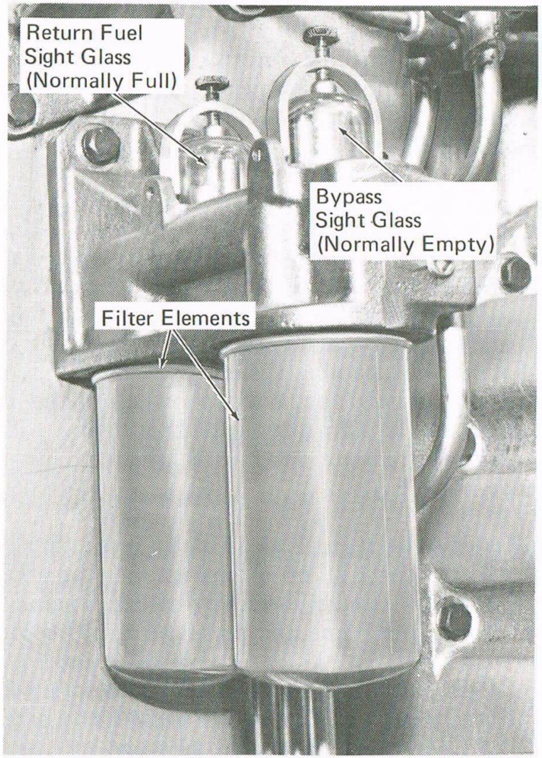


Fig. 3-3 – Fuel Oil Sight Glasses

CAUTION: If engine is equipped with purge control system, do not push injector rack control lever (layshaft) as directed in Step 8, until engine has cranked for six seconds.

8. Position the injector rack manual control lever at about one-third rack (about 1.6 on the scale), then move the FUEL PRIME/ENGINE START switch to the START position (not more than 20 seconds). Hold the switch in the START position until the engine fires and speed increases.

9. Release the injector control lever when the engine comes up to idle speed. Do not advance lever to increase engine speed until oil pressure is confirmed.

10. Check the low water reset button within 50 seconds after engine start. The low water detector will often trip during engine starting, especially on starting after filling a completely drained system. It may also trip after starting a cold engine or one that has had cooling system pressure released. The detector should be reset soon after the engine starts and is idling, or else the engine will shut down after a time delay established by the engine governor.

NOTE: If the detector is difficult to reset after engine start, confirm oil pressure, then position the injector control lever to increase engine speed for a short time and press the reset button.

The reset button on some detectors will not latch in when the engine is shut down. If such a condition exists, the detector will probably function correctly if it can be reset after engine start.

11. Check that cooling water level, lube oil pressure, and governor oil level are satisfactory.

TRAILING UNIT CAB INSPECTION

Switches, circuit breakers, and control equipment located in the cab of a trailing unit should be checked for proper positioning as follows:

Fuse And Switch Panel

1. Main battery switch closed.
2. Ground relay switch closed.
3. Starting fuse installed and in good condition.

Circuit Breaker Panel(s)

1. All circuit breakers in the black area of the circuit breaker panel in the on (up) position.
2. GENERATOR FIELD and AUXILIARY GENERATOR circuit breakers on.
3. Other circuit breakers on as required.
4. Traction motor cutout switch in NORMAL position.

Engine Control Panel

1. ISOLATION switch in START position.
2. HEADLIGHT CONTROL switch in position to correspond with unit position in consist.
3. Other switches may be placed on as needed.

Locomotive Controller

The controller switches and operating handles should be positioned as follows:

1. CONTROL & F. PUMP switch, ENG RUN switch, and GEN FLD. switch must be in off (down) position.
2. Throttle in IDLE.
3. Reverser handle placed in neutral and then removed from the controller to lock the other handles.
4. SERVICE SELECTOR switch in ROAD (AUTO) position.

Air Brakes -- Type 26NL

1. Place automatic brake valve handle in handle-off position. Remove handle (if so equipped).
2. Place independent brake valve handle in full release position. Remove handle (if so equipped).
3. Place MU valve in desired position for trailing unit operation.
4. Place cutoff valve in OUT position.

STARTING TRAILING UNIT DIESEL ENGINES

Engines in trailing units are started in the same manner as the engine in the lead unit.

PLACING UNITS ON THE LINE

After the diesel engines are started and inspected, units may be placed on the line as desired by placing the ISOLATION switch on the engine control panel in the cab in the RUN position. If the consist is at a standstill, be certain that the throttle handles in all units are in IDLE position before placing any unit on the line.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE

The following points should be carefully checked before attempting to move the locomotive under its own power:

1. MAKE SURE THAT MAIN RESERVOIR AIR PRESSURE IS NORMAL (approximately 130-140 pounds).

   This is very important, since the locomotive is equipped with electro-magnetic switchgear which will function in response to control and permit operation without air pressure for brakes.

2. Check for proper application and release of air brakes.
3. Release hand brake and remove any blocking under the wheels.

CAUTION: It is desirable that engine water temperature be 120° F or higher before full load is applied to the engine. After idling at ambient temperature below 0° F, increase to full load level should be made gradually.

HANDLING THE LIGHT LOCOMOTIVE

With the engine started and placed "on-the-line" and the preceding inspections and precautions completed, the locomotive is handled as follows:

1. Place ENG RUN and GEN FLD. switches in on (up) position.

2. Place headlight and other lights ON as needed.

3. Insert reverser handle and move it to the desired direction of travel, either forward or reverse.

NOTE: Engine speed will increase if SERVICE SELECTOR switch is in the SWITCHING 2 position.

4. Place SERVICE SELECTOR switch in position for type of service desired.

5. Depress safety control foot bar or pedal on units so equipped.

6. Release air brakes.

7. Open throttle to position 1, 2, or 3 as needed to move locomotive at desired speed. Locomotive response to throttle movement is almost immediate. There is little delay in power buildup. However, with the SERVICE SELECTOR in SERIES or ROAD position, the generator excitation circuits provide for a softer start than during switching operation.

CAUTION: Engine should not be operated above throttle position 3 until water temperature is greater than 130° F.

8. Throttle should be in IDLE position before coming to a dead stop.

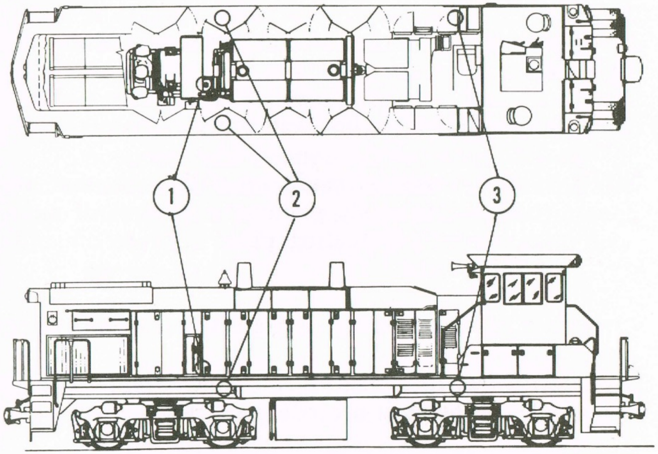
9. Reverser handle should not be moved to change direction of travel until locomotive is completely stopped.

DRAINING OF AIR RESERVOIRS AND STRAINERS

The basic locomotive is equipped with manual drain valves for the main reservoirs and the dirt collector. However, centrifugal filters and automatic drain valves are available as optional equipment.

The air reservoirs and air strainers or filters should be drained at least once each day whether or not equipment is provided with automatic drain valves. Draining should be done at the time of crew change until a definite schedule is established by the railroad.

Momentarily operate the main reservoir, dirt collector, and compressor control strainer drain valves, Fig. 3-4 and 3-5.



1. Compressor Control Strainer Drain Valve
2. Main Reservoir Drain Valve Locations
3. Main Reservoir Dirt Collector Drain Valve

Fig. 3-4 – Compressed Air System Drain Valve Locations

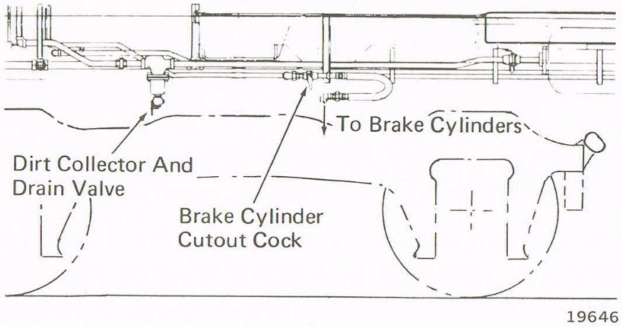


Fig. 3-5 – Main Reservoir Dirt Collector And Drain Valve

COUPLING LOCOMOTIVE UNITS TOGETHER

When coupling units together for multiple unit operation, the procedure below should be followed:

1. Couple and stretch units to ensure couplers are locked.

2. Install control cable between units.

NOTE: If the consist is made up with units that are equipped for only pneumatic control of sanding, connect actuating pipes between all units in the consist.

3. Attach platform safety chains between units.

4. Perform ground, engineroom and engine inspections as outlined in preceding articles.

5. Position cab controls for trailing unit operation as outlined in preceding articles.

6. Connect air brake hoses between units as required by the specific equipment involved.

7. Open required air hose cutout cocks on both units.

NOTE: Units with 26NL brake equipment must have the actuating pipe end hose cutout cock closed at the rear of the locomotive when they are leading units with 6SL or 6BL brake equipment. If two or more units of 26NL brake equipment are connected together and leading the consist, the end hoses must be coupled together between units and the cutout cocks on the actuating pipe line opened on each unit. Units with 26NL brake equipment must have the actuating pipe cutout cock open at both ends when attached to, but trailing units with 6SL or 6BL brake equipment. (This is required to eliminate an undesired brake action occurring on the locomotive.)

A setup of the brakes must then be made on the consist to determine if brakes apply on each unit. Brakes then must be released to determine if all brakes release. The same procedure must be followed to check the independent brake application. Also, release an automatic service application by pressing the independent brake valve handle down. Inspect all brakes in the consist to determine if they are released.

COUPLING LOCOMOTIVE TO TRAIN

Locomotive should be coupled to train using the same care taken when coupling units together. After coupling, make the following checks:

1. Test to see that couplers are locked by stretching connection.

2. Connect air brake hoses.

3. Slowly open air valves on locomotive and train to cut in brakes.

4. Pump up air if necessary, using the following procedure.

PUMPING UP AIR

After cutting in air brakes on train, note the reaction of the main reservoir air gauge. If pressure falls below trainline pressure, pump up air as follows:

1. Place GEN FLD. switch in off (down) position.

2. Move reverser handle to neutral position.

NOTE: A fast idle speed may also be obtained by turning the SERVICE SELECTOR switch to SWITCHING 2 position when reverser handle is positioned for locomotive movement, and the throttle is in IDLE.

3. Open throttle as needed to speed up engine and increase air compressor output.

NOTE: Throttle may be advanced to position 4 or 5 if necessary. Engine should not however be run unloaded (as in pumping up air) at speeds beyond throttle position 5.

BRAKE PIPE LEAKAGE TEST

Prior to operating the 26NL brake equipment, a leakage test must be performed. This is accomplished in the following manner.

1. The cutoff valve is moved to the IN (FRT or PASS) position.

2. Move the automatic brake valve handle gradually into service position until the equalizing reservoir gauge indicates that a 15 psi reduction has been made.

3. Without any further movement of the automatic brake valve handle, observe the brake pipe gauge until this pressure has dropped 15 psi and exhaust has stopped blowing.

4. At this moment turn the cutoff valve to OUT position. This cuts out the maintaining function of the brake valve.

5. From the instant the cutoff valve is turned to OUT position, the brake pipe gauge should be observed and any possible drop in brake pipe pressure should be timed for one minute. Brake pipe leakage must not exceed the rate established by railroad rules.

6. After checking trainline leakage for one minute and the results are observed to be within required limits, return the cutoff valve to the IN (FRT or PASS) position and proceed to reduce the equalizing gauge pressure until the pressure is the same as brake pipe gauge pressure. This is accomplished by moving the automatic brake valve handle gradually to the right until a full service application has been obtained.

7. After pipe leakage test has been completed, return the automatic brake valve handle to release position.

KICKING CARS

When the SERVICE SELECTOR switch is placed in either SWITCHING position, the excitation circuits are set up to produce an immediate tractive effort when the throttle is advanced from the IDLE position. This allows a sudden, yet controlled, application of power. The amount of tractive effort available immediately is directly related to throttle position. That is, tractive effort is low in low throttle positions and high in high throttle positions. This rapid application of power gives the operator a known throttle response. The power control at low throttle positions also simplifies "inching" of cars.

Although operation in either switching mode results in a rapid throttle response, the SWITCHING 2 position provides an even faster acceleration since the engine idles faster in SWITCHING 2 mode.

STARTING A TRAIN (SERVICE SELECTOR SWITCH IN SERIES OR ROAD POSITION)

The method to be used in starting a train depends upon many factors such as, the type of locomotive being used; the type, weight and length of the train and amount of slack in the train; as well as the weather, grade and track conditions. Since all of these factors are variable, specific train starting instructions cannot be provided and it will therefore be up to the operator to use good judgment in properly applying the power to suit requirements. There are, however, certain general considerations that should be observed. They are discussed in the following paragraphs.

A basic characteristic of the diesel locomotive is its high starting tractive effort, which makes it imperative that the air brakes be completely released before any attempt is made to start a train.

The locomotive possesses sufficiently high tractive effort to enable it to start most trains without taking slack. The practice of taking slack indiscriminately should thus be avoided. There will, however, be instances in which it is advisable (and sometimes necessary) to take slack in starting a train. Care should be taken in such cases to prevent excessive locomotive acceleration which will cause undue shock to draft gear and couplers, and lading.

Proper handling is important when starting trains, since it has a direct bearing on the power being developed. As the throttle is advanced, a power increase occurs immediately. The strength of the increase is dependent upon throttle position and is regulated by the generator excitation circuitry.

It is therefore advisable to advance the throttle one notch at a time when starting a train. A train should be started in as low a throttle position as possible, thus keeping the speed of the locomotive at a minimum until all slack has been removed and the train completely stretched. Sometimes it is advisable to reduce the throttle a notch or two at the moment the locomotive begins to move in order to prevent stretching slack too quickly or to avoid slipping.

When ready to start, the following general procedure is recommended:

1. Place SERVICE SELECTOR switch in position for type of service required.
2. Move reverser handle to the desired direction, either forward or reverse.
3. Place ENG RUN and GEN FLD. switches in the on (up) position.
4. Release both automatic and independent air brakes.

5. Open the throttle one notch every few seconds as follows:

   a. To position 1 -- the engine will load. This may be noted on the load current indicating meter. At an easy starting place the locomotive may start the train.

   b. To position 2, 3 or higher (experience and the demands of the schedule will determine this) until the locomotive moves.

6. Reduce throttle one or more notches if acceleration is too rapid.

7. After the train is stretched, advance throttle as desired.

NOTE: When operating at full power to climb a hill, the WHEEL SLIP light may indicate frequent slipping. In such case do not reduce throttle unless severe lurching occurs and there is danger of pulling the train apart.

ACCELERATING A TRAIN

After the train has been started, the throttle can be advanced as rapidly as desired to accelerate the train. The speed with which the throttle is advanced depends upon demands of the schedule and the type of locomotive and train involved. In general however, advancing the throttle one notch at a time is desired to prevent slipping.

The load current indicating meter provides the best guide for throttle handling when accelerating a train. By observing this meter it will be noted that the pointer moves toward the right (increased amperage) as the throttle is advanced. As soon as the increased power is absorbed, the meter pointer begins moving toward the left. At that time, the throttle may again be advanced. Thus for maximum acceleration without slipping, the throttle should be advanced one notch each time the meter pointer begins moving toward the left until full power is reached in throttle position 8.

Additional train acceleration is provided (on locomotives so equipped) by motor field shunting. This change takes place automatically during throttle changes or after reaching full throttle and requires no attention or action on the part of the operator.

SLOWING DOWN BECAUSE OF A GRADE

No changes in motor connection with the main generator occur. One step of decreasing shunt (on units so equipped) occurs automatically and will be indicated by movement of the load current indicating meter pointer. No action is required on the part of the operator.

SW1000 units trailing in a consist may be equipped with D25 generators. Such units may be equipped for transition and shunting. Steps of decreasing shunt will occur automatically, but backward transition (change of motor connection) is not automatic. As the locomotive slows down increased load current may be noted. When load current on the unit approaches 800 amperes, a current limiting relay operates to decrease generator excitation and cause the WHEEL SLIP light to come on and go off. The operator may take the following action:

Reduce throttle position to 6 or lower, and after a moment turn the SERVICE SELECTOR switch to the SERIES position. Reopen the throttle as desired. When the train reaches level or downhill track and increased speed is possible, the SERVICE SELECTOR switch should be returned to the ROAD position.

If operating conditions are such that a momentary lessening of power is not important, backward transition may be accomplished by placing the throttle in IDLE position, and after a momentary delay reopening it as desired.

AIR BRAKING WITH POWER

The method of handling the air brake equipment is left to the discretion of the individual railroad. However, when braking with power, it must be remembered that for any given throttle position, the draw bar pull rapidly increases as the train speed decreases. This pull might become great enough to part the train unless the throttle is reduced as the train speed decreases. Since the pull of the locomotive is indicated by the amperage on the load meter, the operator can maintain a constant pull on the train during a slow down by keeping a steady amperage on the load meter. This is accomplished by reducing the throttle a notch whenever the amperage starts to increase. It is recommended that the independent brakes be kept fully released during power braking. The throttle must be in IDLE before the locomotive comes to a stop.

POWER AT STALL

Do not hold the train at standstill on a grade or with the brakes applied and the throttle open for power. Extensive damage to the traction motors is possible.

OPERATING OVER RAIL CROSSING

When operating the locomotive at speeds exceeding 25 MPH, reduce the throttle to position 4 at least eight seconds before the locomotive reaches a rail crossing. If the locomotive is operating in position 4 or lower, or running less than 25 MPH, allow the same interval and place the throttle in the next lower position.

Advance the throttle after all units of the consist have passed over the crossing. This procedure is necessary to ensure decay of motor and generator voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

RUNNING THROUGH WATER

Under absolutely no circumstances should the locomotive be operated through water deep enough to touch the bottom of the traction motors. Water any deeper than 3" above the rail is likely to cause traction motor damage.

When passing through any water on the rails, exercise every precaution under such circumstances and always go very slowly, never exceeding 2 to 3 MPH.

WHEEL SLIP LIGHT INDICATIONS

The momentary flashing of the WHEEL SLIP light generally indicates a pair of wheels are slipping. Corrective wheel slip relay action automatically reduces the power output of the main generator which thereby reduces traction motor torque, stopping the slipping.

In most cases it will be unnecessary to reduce the throttle because of momentary wheel slip action, as the locomotive will automatically reduce its power to stop the slipping, and reapply the power after the slipping has stopped. However, under extreme rail conditions, slipping may occur repeatedly causing the unit to lurch. In such case the throttle should be reduced to a position that will apply the maximum power permissible without causing excessive slipping. Sand should be used to prevent slipping, not to stop it.

On units equipped to operate in multiple, the WHEEL SLIP light signal is trainlined. When any unit in a consist slips, the light indication appears in all units of the consist.

If a locomotive consist contains SW1000 units equipped with D25 generators, the WHEEL SLIP light is used to indicate that the current limit relay has picked up to limit main generator current. This occurs when locomotive speed decreases after transition has been made. When such WHEEL SLIP light indications appear, it is necessary for the operator to manually initiate backward transition, either by changing SERVICE SELECTOR switch position or by returning the throttle to IDLE position.

LOCOMOTIVE SPEED LIMIT

The maximum speed at which the locomotive can be safely operated is determined by the gear ratio. This ratio is expressed as a double number such as 62:15. The 62 indicates the number of teeth on the axle gear while the 15 represents the number of teeth on the traction motor pinion gear.

Since the two gears are meshed together, it can be seen that for this particular ratio the motor armature turns approximately four times for a single revolution of the driving wheels. The locomotive speed limit is therefore determined by the maximum permissible rotation speed of the motor armature. Exceeding this maximum could result in serious damage to the traction motors.

Although not basically applied, overspeed protective equipment is available for installation on locomotives. The equipment consists of an electro-pneumatic arrangement with many possible variations to suit specific requirements. In general, however, an electrical switch in the speed recorder is used to detect overspeed. This switch in turn initiates certain air brake functions which reduce train speed.

POWER REDUCTION (HUMP) CONTROL

When applied, the hump control circuit controls main generator excitation. The combination of throttle setting (engine RPM) and main generator excitation voltage produces the power to move the train. Locomotive power can therefore be reduced by reducing the throttle setting. However, using the hump control to reduce power in smaller increments better suits the operating conditions peculiar to humping service. Reducing the excitation as the load lessens makes possible a fine balance between power output and power required.

DOUBLE HEADING

Prior to double heading behind another locomotive, make a full service brake pipe reduction with the automatic brake valve, and place the cutoff valve in OUT position. Return the automatic brake valve handle to the release position and place the independent brake valve in release position. On 26NL equipment place the MU valve in LEAD position.

The operation of the throttle is normal, but the brakes are controlled from the lead locomotive. An emergency air brake application may be made, however, from the automatic brake valve of the second unit. Also, the brakes on this unit may be released by pressing the independent brake valve handle down while it is in the release position.

ISOLATING A UNIT

A locomotive unit in a multiple unit consist may be isolated at any time by turning the ISOLATION

SWITCH to ISOLATE, but discretion as to timing and necessity should be used.

CHANGING OPERATING ENDS

When the locomotive consist includes two or more units with operating controls, the following procedure is recommended in changing from one operating end to the opposite end on locomotives equipped with 26NL brakes.

ON END BEING CUT OUT

1. Move the automatic brake valve handle to service position and make a 20 pound reduction.

2. After brake pipe exhaust stops, place cutoff valve in OUT position by pushing dial indicator handle in and turning to the desired position.

3. Place independent brake in fully released position.

4. Place MU valve in the desired TRAIL position, depending on brake equipment on trailing units. (MU valve is located on the left side of control console. Push dial in and turn to desired position.)

5. Position automatic brake valve in handle off position. (Handle may be removed if so equipped.)

6. Place reverser handle in neutral position and remove to lock controller.

7. At the controller, place all switches in the off position. Ensure that CONTROL & F. PUMP, GEN FLD., and ENG RUN switches are in off (down) position.

8. On the engine control panel, place HEADLIGHT CONTROL switch in proper position for trailing unit operation. Place other switches on as needed.

9. At the circuit breaker panel, the CONTROL and LOCAL CONTROL circuit breakers remain in the on position.

NOTE: If the LOCAL CONTROL circuit breaker is inadvertently placed off at this time, the engine will shut down when the trainlined control circuit is re-established. However, the engine may be restarted in the normal manner after placing the LOCAL CONTROL circuit breaker on.

10. After completing the operations outlined in the preceding steps, move to the cab of the new lead unit.

ON END BEING CUT IN

1. At the controller, make certain throttle lever is in IDLE and the GEN FLD. switch is in off (down) position.

2. Insert reverser handle and leave in neutral position.

3. Insert automatic brake valve handle (if removed) and place in suppression position to nullify any safety control, overspeed, or train control used.

4. Insert independent brake valve handle (if removed) and move handle to full independent application position.

5. Position cutoff valve to IN (FRT or PASS) position.

6. Place MU valve in LEAD position.

7. At the circuit breaker panel, check that the CONTROL circuit breaker is in the on position. Other circuit breakers remain on.

8. At the engine control panel, place the HEADLIGHT CONTROL switch in proper position, and other switches on as needed.

9. At the controller, place the CONTROL & F. PUMP, GEN FLD., and ENG RUN switches in on (up) position. Other switches may be placed on as needed.

STOPPING ENGINE

There are six ways to stop the engine.

1. Press EMERGENCY FUEL CUT-OFF & ENGINE STOP pushbutton on engine control panel.

   The action of this pushbutton is instantaneous and therefore it need not be held in. It is recommended, however, that the ISOLATION switch be set to STOP first before pressing the pushbutton.

2. Press one of the two EMERGENCY FUEL CUT-OFF pushbuttons located near each fuel filler opening.

   These pushbuttons operate in the same manner as the EMERGENCY FUEL CUT-OFF & ENGINE STOP pushbutton on the engine control panel and need not be held in nor reset.

3. Use injector rack manual control lever.

   This lever at the accessory end of the engine can be operated to override the engine governor and move the injector racks to the no fuel position.

4. Close the low water pressure detector test cock.

   When the low water pressure detector trips, oil is dumped from the governor low oil shutdown device, stopping the engine.

5. Use throttle handle.

   To stop all engines "on the line" in a consist simultaneously from the cab of the lead unit, move the throttle to the IDLE position, pull the handle out and away from the controller, and move it beyond IDLE to the STOP position.

6. Pull out low oil shutdown plunger on the side of the governor.

CAUTION: Observe freezing weather precautions whenever an engine is shut down during cold weather.

SECURING LOCOMOTIVE FOR LAYOVER

1. Place the reverser handle in neutral position and the throttle in IDLE.

2. Set ISOLATION switch to STOP and press EMERGENCY FUEL CUT-OFF & ENGINE STOP pushbutton on engine control panel.

3. Place all switches on the controller in the off position (down).

4. Place all circuit breakers and switches on the circuit breaker panel and the engine control panel in the off position and open all knife switches.

5. Apply hand brake and block wheels, if necessary.

6. Cover exhaust stacks if there is danger of a severe rain.

7. Drain or otherwise protect engine if there is danger of freezing.

TOWING LOCOMOTIVE IN TRAIN

When a locomotive unit equipped with 26NL air brakes is placed within a train consist to be towed, its control and air brake equipment should be set as follows:

1. Drain all air from main reservoirs and air brake equipment unless engine is to remain idling.
2. Place the MU valve in DEAD position.
3. Place cutoff valve in OUT position.
4. Place independent brake valve handle in release position.
5. Place automatic brake valve handle in handle-off position.
6. Cut in dead engine fixture by turning cutout cock, Fig. 2-13, to open (90° to pipe) position. Dead engine cock is located beneath cab floor and may be reached through an access door at side of locomotive.

CAUTION: The pressure regulator shown in Fig. 2-13 is adjusted at a maintenance point in accordance with the type of brake equipment used. The locomotive operator should not attempt to adjust braking pressure.

7. If engine is to remain idling, switches should be positioned as follows:
   a. ISOLATION switch in START position.
   b. All knife switches closed.

   c. LOCAL CONTROL and CONTROL circuit breakers on.
   d. Starting fuse should be removed.
   e. GENERATOR FIELD circuit breaker off.
   f. CONTROL & F. PUMP switch on (up).
   g. FUEL PUMP circuit breaker on.
   h. Throttle in IDLE, reverser handle centered. Remove reverser handle from controller to lock controls.
8. If locomotive is to be towed dead in a train, switches should be positioned as follows:
   a. All knife switches open.
   b. All circuit breakers off.
   c. All control switches off.
   d. Starting fuse removed.
   e. Throttle should be in IDLE, and reverser handle should be removed from controller.

NOTE: If there is danger of freezing, the engine cooling system should be drained.

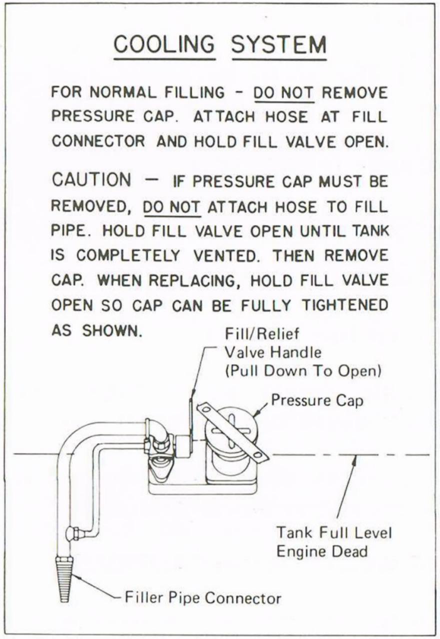
FREEZING WEATHER PRECAUTIONS

As long as the diesel engine is running, the cooling system will be kept adequately warm regardless of ambient (outside) temperatures encountered. It is only when the engine is shut down or stops for any reason that the cooling system requires protection against freezing.

In instances where danger of freezing is present, the cooling system should be completely drained or have steam admitted. The draining procedure is as follows:

1. Open the drain valve located at the floor in front of the engine. This will drain the engine radiators, water tank, oil cooler, and air compressor.

2. After cooling system pressure has been released and draining has slowed, remove the water tank fill cap to allow faster draining, Fig. 3-6.



COOLING SYSTEM

FOR NORMAL FILLING - DO NOT REMOVE PRESSURE CAP. ATTACH HOSE AT FILL CONNECTOR AND HOLD FILL VALVE OPEN.

CAUTION — IF PRESSURE CAP MUST BE REMOVED, DO NOT ATTACH HOSE TO FILL PIPE. HOLD FILL VALVE OPEN UNTIL TANK IS COMPLETELY VENTED. THEN REMOVE CAP. WHEN REPLACING, HOLD FILL VALVE OPEN SO CAP CAN BE FULLY TIGHTENED AS SHOWN.

Fill/Relief Valve Handle (Pull Down To Open)
Pressure Cap
Tank Full Level Engine Dead
Filler Pipe Connector
20125

Fig. 3-6 – Cooling System Pressure Cap And Filler/Relief Arrangement

LEAVING LOCOMOTIVE UNATTENDED

If at any time it is necessary to leave the locomotive unattended while the engine is running, the following procedure should be adhered to.

1. Observe all railroad safety precautions.

2. Place ENG RUN and GEN FLD. switches in the off (down) position.

3. Place throttle in IDLE and remove reverser handle from controller to lock the controls.

SECTION 4

TROUBLESHOOTING

INTRODUCTION

This section covers operational problems that may occur on the road and suggests action that may be taken by the operator in response to the trouble.

Safety devices automatically protect equipment in case of faulty operation of almost any component. In general this protection is obtained by one of the following methods.

1. Complete shutdown of the diesel engine.
2. Unloading of the diesel engine.
3. Unloading of the diesel engine and restriction to idle engine speed.

Condition	Probable Cause	Suggested Operator's Response
HOT ENG light on; alarm bell ringing.	Temporary operating condition.	If temperature does not return to normal in a reasonable time, shut the unit down. Before shutdown, make the following checks. Check cooling water level. Check that shutters are open and fan is operating. If shutters are closed, operate test valve located in the vicinity of the water tank instruction plate. If valve operation opens the shutters, and temperature returns to normal, operation may continue to the nearest maintenance point.

Condition	Probable Cause	Suggested Operator's Response
HOT ENG light on; alarm bell ringing.	Tunnel or desert operation	No action necessary unless alarm continues for more than a few minutes. If alarm continues, isolate the affected unit. If water level is too low, shut the engine down. If freezing conditions are possible, drain the cooling system in accordance with railroad regulations.

WARNING: If governor low oil plunger trips to shut the engine down, but the crankcase and low water detector buttons remain set, check oil and water levels. If oil level is satisfactory and water level is marginal, the hot oil detector may have tripped. There is no indicator for such a trip except a very hot engine condition. Do not attempt to restart engine. Report engine shutdown circumstances to authorized maintenance personnel.

Condition	Probable Cause	Suggested Operator's Response
GOV DOWN light on.	Low water due to leak, or low oil due to leak, or crankcase pressure due to cracked piston or bad cylinder seals, or hot oil due to plugged oil cooler.	If shutdown is due to low water, the addition of water may permit continued operation. Otherwise place the ISOLATION switch in ISOLATE position. If freezing conditions are possible drain the cooling system in accordance with the railroad regulations.

WARNING: If crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. If freezing conditions are possible, drain the cooling system in accordance with railroad regulations.

Condition	Probable Cause	Suggested Operator's Response
GRD RELAY light on; alarm ringing.	Ground relay action.	Wait at least 10 seconds, then press the GROUND RESET push-button. If two more ground relay actions occur, isolate the unit. If a traction motor fault is the cause of the ground relay action, the locomotive may return independently to the maintenance point, by operating the cutout switch on the circuit breaker panel to cut out the truck containing the defective motor.

CAUTION: Do not tow or operate a locomotive unless absolutely sure that all of its wheels rotate freely.

Do not pull cars with a truck cut out. Do not operate at more than half throttle with a truck cut out.

Condition	Probable Cause	Suggested Operator's Response
Alarm bell rings - No warning lights on in lead unit.	Ground relay action in trailing unit.	Same response as above.
	Trailing unit shut down.	Check warning lights in cab of affected unit. If no lights are on, check overspeed lever at accessory end of engine. Reset if required and restart engine. If overspeed occurs again, operation at reduced throttle may prevent the overspeed trip. If not, isolate the unit and allow it to remain shut down.

Condition	Probable Cause	Suggested Operator's Response
PCS OPEN light on.	Penalty brake application.	Move throttle to IDLE. Move brake valve handle to handle-off position, and then to release position.
	Emergency brake application.	Move throttle to IDLE position. Move brake handle to emergency position and wait 45 seconds before moving handle to release position. NOTE: Follow railroad regulations after any penalty or emergency brake application.
Intermittent WHEEL SLIP light indications.	Normal wheel slip correction under severe conditions.	No action required. Do not reduce throttle unless slipping is so severe that it threatens to break the train.

Condition	Probable Cause	Suggested Operator's Response
Excessive WHEEL SLIP light indications.	Locked sliding wheels.	Check that all wheels on the locomotive rotate freely. Do not operate a locomotive unless all wheels rotate freely.
	Control or transmission system fault.	Cut out a pair of traction motors and check operation. If the slipping condition is corrected with a truck cut out, return the unit to a maintenance point.

CAUTION: Do not pull cars with a truck cut out. Make certain that all wheels rotate freely before moving the locomotive.

Do not operate at more than half throttle with a truck cut out.

Condition	Probable Cause	Suggested Operator's Response
Engine does not respond to throttle.	Tripped circuit breaker; Control switches improperly positioned.	Check the CONTROL circuit breaker and the ENG RUN switch. Check electrical cable at the engine governor.
Trailing units do not respond to throttle.	LOCAL CONTROL circuit breaker tripped in trailing unit.	Reset breaker.
	Jumper cable between units not securely connected.	Secure jumper cable.

Condition	Probable Cause	Suggested Operator's Response
Engine responds to throttle but no power is developed.	CONTROL circuit breaker tripped.	Check CONTROL circuit breaker.
	Reverser handle centered.	Place reverser handle in an operating position.
	GEN FLD switch off.	Check position of GEN FLD switch; also check position of ISOLATION switch.

Condition	Probable Cause	Suggested Operator's Response
	Electrical system fault.	With SERVICE SELECTOR switch in SERIES or ROAD position, and the unit developing no power with throttle at position 1, check position of load regulator. If load regulator is at maximum field position, there is a fault in the excitation system preventing excitation of the main generator. If the load regulator is at minimum field position, there is a fault in the governor or governor circuits.